SAMS-FF: Monitoring the Microgravity Environment in Support of Space Research and the Hubble Space Telescope

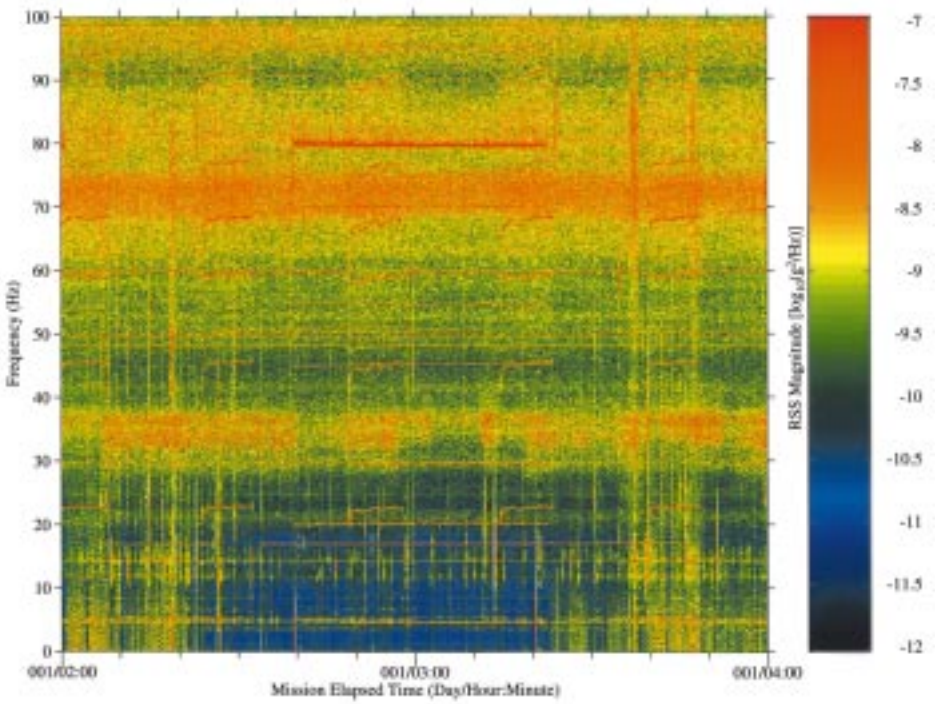
When a space shuttle is in low Earth orbit, it is in a state of freefall around the Earth. This freefall results in a unique low-gravity environment called microgravity, in which researchers can conduct many types of investigations. The microgravity environment is characterized by a reduction in the effects of gravity compared to what is experienced on Earth. Small vibrations and accelerations onboard the shuttle, however, can affect experiments in ways similar to gravity. Such disturbances can be too small for crewmembers to detect, but very sensitive measurement devices can detect them. Acceleration measurement instruments assess the microgravity environment using specially designed sensors, which allow scientists to characterize these disturbances and study their influence on experiment results.

One of two sensor heads that make up the SAMS-FF unit for STS-95 mounted in a hermetic enclosure

On STS-95, a Space Accelerations Measurement System (SAMS) instrument designed for free-flyers (suborbital rockets and satellites), called SAMS-FF, will be placed in the shuttle's cargo bay. This is a new generation of SAMS, which, due to technology advancements, is smaller, lighter, and has improved performance. SAMS-FF will record any disturbances in the general microgravity environment during the Hubble Space Telescope Orbital Systems Test (HOST). HOST is a trial of a new cryocooler for the Hubble Space Telescope. As the cryocooler cools the telescope's near infrared camera and multi-object spectrometer, SAMS-FF will collect vibratory disturbance data. These data will be used by HOST personnel to determine whether operation of the cooler causes disturbances that may affect the ability to precisely point the telescope at a desired location and collect high-quality images. The Hubble Space Telescope has strict requirements for a low-vibration environment.

Although SAMS units have supported microgravity science research on 20 shuttle missions since 1991, the use of a SAMS-FF unit on the shuttle in support of astronomy research is new. SAMS-FF's vibration measurement capabilities, developed under the Microgravity Research Program and successfully demonstrated in the microgravity sounding rocket and KC-135 programs, were requested by Goddard Space Flight Center to support this mission.

For STS-95, the SAMS-FF unit will be positioned near the cryocooler. One sensor will be attached directly to the HOST and will measure the disturbances produced during operation of the cryocooler. A second sensor will be attached to the cryocooler's mounting plate and will characterize the overall microgravity environment of the shuttle. This data will be available to scientists with microgravity experiments on this flight. After the mission, Principal



Graph of disturbance data collected by a SAMS unit. The data illustrate the acceleration magnitude (in color) versus frequency in hertz (Hz) over time. The dark red horizontal line at 80 Hz is due to an experiment's water pump, which was on for about 40 minutes. The narrow vertical lines are primarily due to jets being fired to maintain the shuttle's attitude. The periodic, short, red traces at around 23 Hz (with harmonics at 46, 69, and 92 Hz) are due to a refrigerator compressor motor, which cycles on and off to maintain the temperature of the refrigerator.

Investigator Microgravity Services (PIMS) personnel will work with the HOST and SAMS-FF teams to analyze and correlate data on the cryocooler with other ancillary data from the mission. The data will be analyzed to compare the microgravity environment for HOST while the cryocooler was in operation and while it was turned off. In addition, the data will be compared to acceleration data collected by SAMS-FF during ground characterization testing of the cryocooler. These analyses will assist researchers in their assessment of the cryocooler's usefulness for the Hubble telescope and will give other microgravity researchers on STS-95 important information they can use in the analysis of experiment results.

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